DECEMBER 23, 1991
CHEMICAL & ENGINEERING

Chemical companies hold the line on capital spending
Page 9

NEWS

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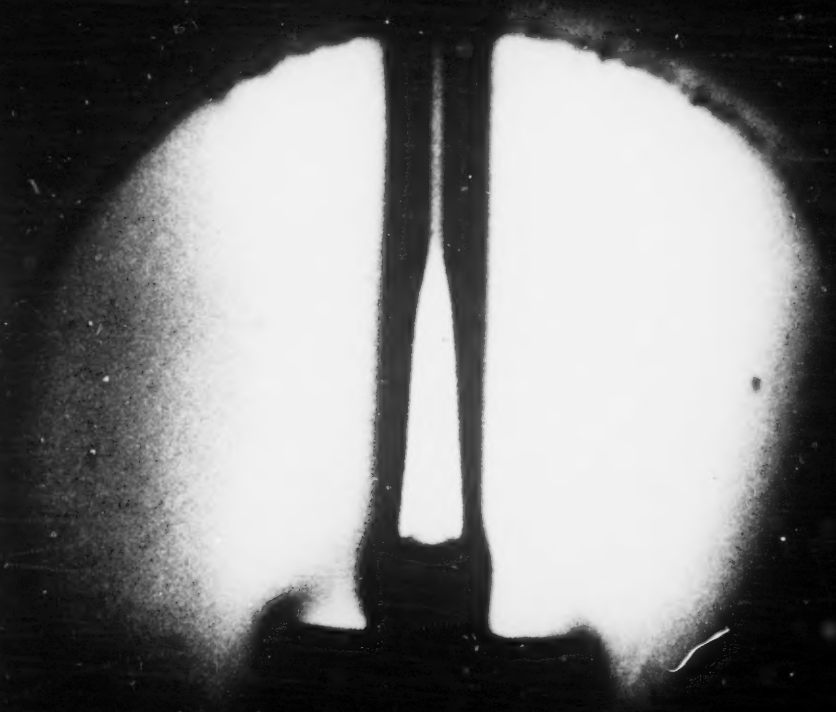

SUPERCRITICAL WATER

A medium for novel chemical reactions
Page 26

CHEMICAL & ENGINEERING
NEWS
Volume 69, Number 51
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DECEMBER 23, 1991

News of the Week

■ **Union Carbide plans to split into two companies next year, a chemical and plastics unit bearing the Carbide name, and an as-yet-unnamed industrial gases firm.** **Page 4**

■ **Worst job market in 20 years is projected for next June's college graduates, though B.S. chemists may buck the hiring trend.** **Page 5**

■ **Annual Christmas show of "chemical magic" is performed by University of Wisconsin's Bassam Shakhashiri.** **Page 5**

■ **U.S. approach to controlling low-level ozone, a major smog component, has essentially failed and major changes are needed, finds a recent study.** **Page 6**

■ **Explosion in a benzoic acid tank at a chemical complex of Dutch chemical firm DSM in Rotterdam kills six people.** **Page 6**

■ **Du Pont is taking a huge write-off for damage to greenhouse nursery plants caused by its fungicide Benlate.** **Page 6**

Cover: Flame burns in supercritical mixture of water and methane in work at the University of Karlsruhe, Germany

Letters 2

Concentrates
Business 7
Government 14
Science/Technology 16

The Departments
ACS Comment 40
ACS News 41
Newscripts 52

Business

Global capital spending by major U.S. chemical firms will rise slightly in 1992, as the economy continues to languish. **Page 9**

Government

EPA will review policy on risk assessments at Superfund hazardous-waste sites following legal challenge by the Chemical Manufacturers Association and other industry groups. **Page 15**

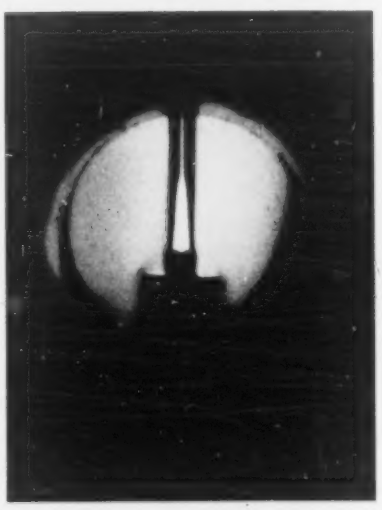
Science/Technology

Chem Show exhibits reflect influence of environmental concerns and new construction materials on process equipment design. **Page 17**

Recent CHEMRAWN conference tackles effects human activities are having on the atmosphere as well as effects atmospheric changes are having on humans and Earth. **Page 21**

Public Policy

Academic research and its problems and future were explored in a meeting sponsored by NAS's roundtable group. **Page 23**



Special Report

Supercritical water is emerging as a medium that could provide the optimum conditions for a variety of chemical reactions, among them the destruction of hazardous waste. **Page 26**

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LETTERS

A true hero

I want to commend you for your article "Milton Harris: a Distinguished, Joyous Life in Chemistry" (C&EN, Nov. 4, page 42). Your title was just right in describing the wonderful, productive life that Harris lived.

I met him in 1962 when I was a young program director in chemistry at the National Science Foundation. I was very active in ACS and became friends with him at that time. Harris gave me a great deal of useful help both professionally and personally. He was a wise, kind, and thoughtful man, always willing to take time from his busy schedule to be helpful to others. I know that what he did for me he also did for hundreds of others throughout his long and distinguished career.

I wish ACS would produce a booklet on his life and career, to be used to inspire high school students. You could show how one person can do so much for society through chemistry. Harris is a hero of true character as contrasted to many of the sports heroes of today who all too often betray their youthful followers.

Robert H. Linnell
President, Harmony Institute Inc.
Tollhouse, Calif.
Professor Emeritus, University of Southern California

Faraday exhibits in London

On a recent trip to London I came across a few items relating to Michael Faraday that I thought C&EN readers might find interesting, especially after reading your cover story (C&EN, Sept. 23, page 17).

• The Science Museum has a special exhibit, "Michael Faraday and the Modern World," which covers Faraday's life and work, modern applications, and many hands-on experiments. The really special event of the exhibit is a young actor (Robert Hulse) who does a first-person interpretation of a Faraday lecture. This fellow has the science and history together and does a lively presentation.

• The Royal Institution has restored Faraday's laboratory in the basement of its building at 21 Albermarle St. It's open to the public on a regular basis on Tuesday and Thursday afternoons. On display are many of his original experimental pieces, including Faraday's ring (not a piece of jewelry), the great electromagnet, samples of optical glass and steel alloys prepared by Faraday, and many of his journals and letters.

• The Royal Institution also has for sale a good selection of publications on Faraday and his work, including a little 36-page booklet, "Advice to Lecturers," taken from the writings of Faraday and Lawrence Bragg. It's a piece that should be required reading for all of us who ever stand up before an audience.

• Michael Faraday has replaced Shakespeare on the back of the £20 note. I see that as a good sign for science and technology.

Bierce Riley
Morristown, N.J.

Raising gasoline taxes

Along with David Montgomery, I authored the Charles River Associates (CRA) report criticized by William J. Sapone (C&EN, Nov. 4, page 4). Although C&EN's description of our report findings (Sept. 23, page 12) is accurate and fair, I wish to clarify the points where Sapone misunderstands our report, its conclusions, and the motivations that underlay its creation.

CRA's report, "Policy Alternatives for Reducing Petroleum Use and Greenhouse Gas Emissions," was commissioned as an independent study by the Motor Vehicle Manufacturers Association (MVMA) to analyze a variety of policies that might be implemented to save petroleum, including increased corporate average fuel economy (CAFE) standards and gasoline taxes. We concluded, among other things, that raising gasoline taxes would be a cheaper way of saving petroleum than mandating increased fleet fuel economy standards.

Sapone's argument is based on an incorrect notion that driving patterns are not affected by gasoline prices. For example, he erroneously states that "people primarily use their cars for work and that type of driving cannot be curtailed." In fact, work trips account for less than 40% of all auto travel in the U.S. And because he does not take account of price sensitivity, he mistakenly believes that gasoline taxes and increased CAFE standards will have the same impacts on petroleum use. He argues that consumers will respond to

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Chemical Capital Spending Forecast To Rise Modestly in 1992

Caution is watchword for major U.S. chemical firms as recession continues, but spending on pollution control will continue unabated

Marc S. Reisch,
C&EN Northeast News Bureau

Spending for plant efficiency, incremental increases in capacity, and government-mandated pollution abatement will likely characterize capital expenditures in 1992. As a result, in the absence of significant grassroots construction, worldwide capital spending by major U.S. chemical producers will increase only modestly in the next 12 months, according to preliminary forecasts of plans by leading chemical producers.

For eight chemical producers responding out of the 12 that C&EN surveys annually, 1992 capital expenditures will increase a modest 4% from 1991 to a combined $7 billion. That forecast follows an 11% drop in 1991, also gleaned from this year's survey.

However, of the eight chemical producers, only one—PPG Industries—expects to increase such spending significantly. A PPG spokesman says virtually all of the 14% increase planned in 1992, some $40 million to $50 million, will be directed to environmental expenditures for the company's chemical business. Four other companies intend to spend less than in 1991 on capital projects or plan no increase at all. Two others will increase spending, but not by so large a percentage as PPG.

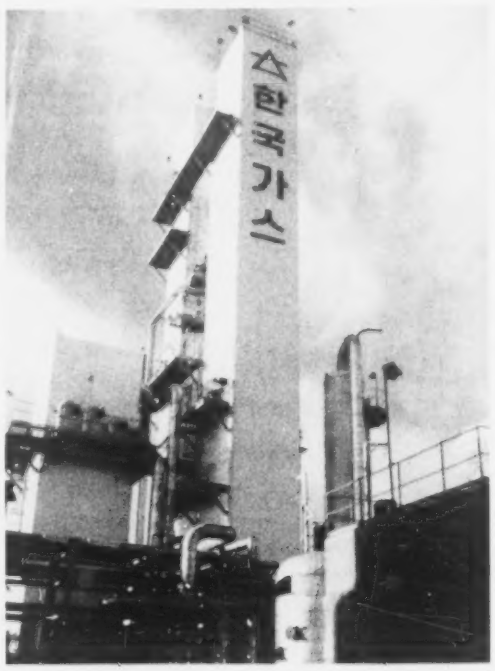
According to Du Pont chief economist Richard A. Stuckey, in contrast to consumer confidence, business confidence has not plunged. However, business executives are nonetheless hesitant about spending money for capital improvements in the current languishing economy. As a result, Stuckey says, industry's spending for capital projects will be directed mostly at efficiency improvements, expansions of existing capacity, and spending related to environmental considerations.

Pollution abatement spending is a constant in capital budgets and is not subject to the cyclical influences that affect decisions to add capacity or build new plants from the ground up, notes Stuckey. In addition, a large part of any one year's capital budget goes for the installation of equipment to produce products that are considered more "environmentally friendly" than the products they replace. Such would be the case for investments in water-thinned acrylic polymers for paint to replace solvent-thinned alkyd resins. Another might be investments in replacements for chlorofluorocarbons used as refrigerants and blowing agents.

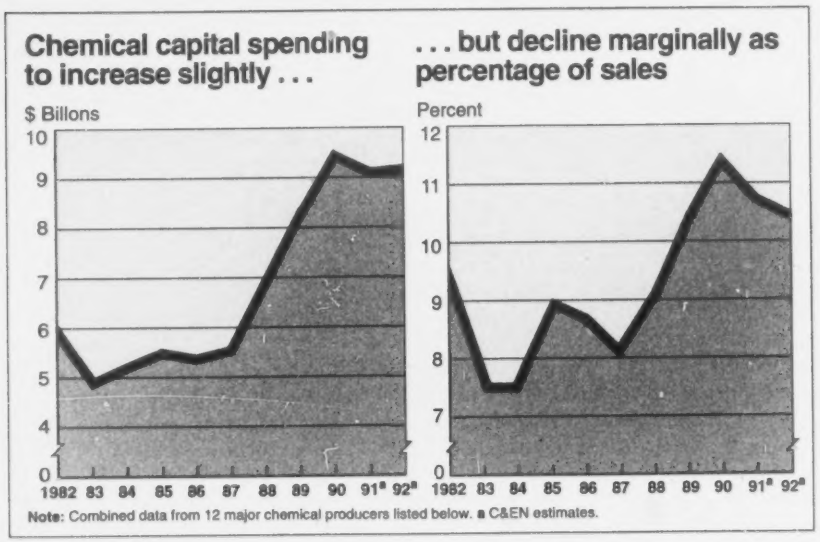
Totaling up costs for new products intended to replace older, less "environmentally friendly" products would be difficult, but the costs would be significant. Stuckey says the addition of pollution abatement equipment in the expansion of existing product lines often doubles the cost of the expansion.

Saadat Sayal, vice president of international marketing for the Greater Houston Partnership, says chemical industry spending in the Houston area has slowed significantly since the 1987–89 period. Houston is a major center of the U.S. petrochemical industry, and the partnership promotes area commercial development. The most significant capital projects under way now in the Houston area are expansions for methyl *tert*-butyl ether, a gasoline additive that helps motor vehicles meet government-mandated exhaust limits, notes Sayal. Where companies are planning investments, they are doing so to come into compliance with environmental regulations. In a number of instances, he notes, chemical producers are planning individual investments of up to $100 million each to bring their complexes into compliance.

In the Commerce Department's 1988 survey of capital expenditures for pollution abate-



Air Products joint venture industrial gas plant in South Korea is currently being expanded



Note: Combined data from 12 major chemical producers listed below. a C&EN estimates.

ment, chemical industry spending to curb air and water pollution and solid waste was estimated to make up nearly 7% of total chemical capital spending of $19.3 billion. Although the government no longer publishes this survey, other sources indicate that the percentage is up significantly from what it was as little as three years ago.

The Chemical Manufacturers Association's (CMA) annual industry survey provides data showing that chemical industry costs for air, water, and solid-waste abatement totaled about $1.8 billion in 1990, or nearly 9% of 1990 industry capital expenditures. However, using a measure of gross industry spending that excludes spending of diversified chemical companies on nonchemical businesses, CMA indicates that 17% of industry capital expenditures of $11.5 billion in 1991 were for pollution controls. It says that that percentage will rise to 22% of industry spending of $12.6 billion in 1992. Most chemical companies surveyed by C&EN say pollution spending as a percentage of their total capital spending would grow.

But while spending on pollution abatement is on the increase, most expansion projects for the industry are on hold. The past year, after all, has been a trying one for the chemical industry. Since the middle of 1989, demand for chemicals has been declining. Though CMA predicts record U.S. chemical exports of $43.5 billion this year, exports do not ultimately substitute for the serious lag in domestic demand. As a result, capacity utilization rates have dropped. In its annual report on the industry's economic performance, CMA pegs average 1991 capacity use at 78.7%, down substantially from the 1990 rate of 81.4%. The industry operated at peak capacity as recently as August 1988, when capacity utilization reached 86.8%.

A significant reason for the low chemical industry capacity use is that major automotive and construction industry customers are themselves in a deep economic rut. With capacity use down and prices up hardly enough to account for inflation, the chemical industry cannot justify huge increases in capacity expansions. And even if it took a long-term perspective, and forgot Wall Street looking over its shoulder, the industry's nine-quarter earnings slide would make industry management leery of spending cash without good reason.

As a result of the continuing uncertain economy, companies are very late in planning next year's capital budgets. This is the fourth year in a

Capital spending of surveyed companies will increase 4% next year

	1992		1991		Worldwide					Change from previous year	
$ Millions	Total	U.S.	Total	U.S.	1991 planned[a]	1990	1989	1988	1987	1992	1991
Air Products[b]	$ 492	$ 364	$ 506	$ 338	na	$ 468	$ 414	$ 409	$ 323	−3%	8%
American Cyanamid[c]	385	285	385	285	$ 370	376	398	374	268	0	2
Dow Chemical	2000	1200	2000	1100	2000	2119	1756	1264	995	0	−6
Du Pont[d]	2970	2020	2735	1915	3170	3142	2563	2029	1674	9	−13
Ethyl[e]	165	115	175	105	185	166	119	151	139	−6	5
W. R. Grace	na	na	400	na	na	514	485	418	243	na	−22
Hercules	200	160	225	180	225	273	293	251	205	−11	−18
Monsanto	na	na	600	na	na	750	607	590	505	na	−20
Olin	na	na	195	na	na	187	142	147	115	na	4
PPG Industries	400	225	350	200	450	567	671	410	426	14	−38
Rohm & Haas	300	200	285	190	325	412	385	338	222	5	−31
Union Carbide	na	na	750	525	na	744	726	608	452	na	1
TOTAL	$6912	$4569	$5606	$4838	$6725	$9718	$8559	$6989	$5567		
ANNUAL CHANGE[f]	4%	6%	−11%	−14%		14%	22%	26%	4%		

a Earliest estimate. b Fiscal year ends Sept. 30. c 1990, 1991, and 1992 excluded Shulton Group, which has been sold. d Excludes Conoco. e 1989, 1990, 1991, and 1992 figures adjusted to reflect spin-off of Tredegar Industries in July 1989. f Cumulative changes for companies reporting. na = not available.

row when fewer than 11 companies have responded to C&EN's December survey. Although 11 firms responded in 1987, only nine responded in 1988 and eight in 1989, 1990, and 1991.

Companies responding this year were Air Products & Chemicals, American Cyanamid, Dow Chemical, Du Pont, Ethyl, Hercules, PPG Industries, and Rohm & Haas. Missing this year are W. R. Grace, Monsanto, Olin, and Union Carbide.

Though the survey shows an average increase of 4% in capital expenditures for reporting companies, most individual companies plan a decrease or no increase at all. Hercules plans to decrease capital expenditures in 1992 by 11% to $200 million; Ethyl, 6% to $165 million; and Air Products, 3% to $492 million. Dow and American Cyanamid plan to spend about the same as in 1991—$2 billion for Dow and $385 million for American Cyanamid. On the positive side, three companies plan an increase in capital spending. In addition to PPG's 14% increase to $400 million, Du Pont plans a 9% boost to nearly $3 billion, and Rohm & Haas a 5% hike to $300 million.

Despite the modest increase in capital expenditures planned for the group, C&EN estimates industry capital spending as a percentage of sales will weigh in at a hefty 10.4% for 1992. That projection not only is based on the 4% average increase in capital expenditures for reporting companies, but also on the assumption that the four who did not respond will collectively increase spending at about the same rate. The prediction also assumes that 1992 will see a modest recovery in chemical industry sales of 4%.

For 1991, C&EN estimates that companies surveyed spent 10.7% of sales on capital projects. That figure is based on the assumption that sales grew 2% in 1991 for the 12 firms surveyed. It also assumes that capital expenditures for the group of 12 declined 11%, instead of a 3% decline predicted last year for the group (C&EN, Dec. 24, 1990). The recent highs in capital spending as a percentage of sales indicates that project commitments made during better economic times are still under way.

Although C&EN's survey points to a marginal 4% increase in industry capital spending for 1992, CMA's survey of members predicts a 10% increase in 1992. C&EN's survey and CMA's survey have disagreed in the past. Last year CMA predicted industry spending would increase 13% in 1991, but this year it has revised 1991 estimates downward to only a marginal 1% increase. Last year's C&EN survey of 1991 capital spending predicted a 3% drop, and in this year's survey the drop for 1991 looks even greater: an 11% decline.

This year's survey also predicts 1992 U.S. capital spending will increase at a faster pace than spending by responding companies worldwide. Six plan to increase spending domestically, one plans to keep spending at the same rate, and only one plans to decrease spending. PPG leads the group with a planned increase of 13% to $225 million in domestic capital spending, followed by Ethyl, with an increase of 10%. Dow plans to increase domestic spending 9% to $1.2 billion; Air Products, 8% to $364 million; and Rohm & Haas and Du Pont, 5% to $200 million and $2 billion, respectively. American Cyanamid plans to spend the same amount domestically—$285 million—as it spent in 1991. Hercules' planned U.S. spending will be down 11% to $160 million. □

German chemical giants slow U.S. spending

The three German chemical giants, BASF, Bayer, and Hoechst, forecast their 1992 capital expenditures in the U.S. will increase only 1% from this year's spending. However, only one of the three, Bayer, gives any indication of how much it intends to spend on capital projects worldwide.

In the U.S., Hoechst Celanese plans the largest increase in capital expenditures, up 10% from 1991 to $550 million. Meanwhile, Bayer, which will operate in the U.S. under the name Miles Inc. beginning in January, plans to increase spending 5% to $325 million. Only BASF plans an actual decrease in U.S. capital expenditures in 1992, down 9% to $500 million.

The combined 1% increase in U.S. spending for the three follows a 9% increase in 1991 expenditures compared with 1990 spending. For 1991, Hoechst Celanese raised capital expenditures 25% to $500 million. However, the data this year include expenditures for Celanese Mexicana, which were not included in previous years' data. BASF increased its capital expenditures 5% this year to $550 million and completed a number of projects including a textile nylon filament plant in Anderson, S.C.; a urethane specialties plant in Clemson, S.C.; and a thermoplastic polyurethane elastomer resin facility in Wyandotte, Mich. Bayer USA decreased spending 5% in 1991 to $310 million.

Bayer plans to spend $1.9 billion worldwide, down 3% from expenditures in 1991. Bayer is also the only German company that had a strong fix on actual 1991 expenditures and was willing to disclose them for C&EN's survey. The company predicts 1991 capital expenditures of nearly $2 billion, down 16% from 1990.

Because of the increase in the dollar's value, the German chemical companies will find it more expensive to finance U.S. capital expenditures with deutsche marks. Last year C&EN used a conversion rate of $1.00 = 1.5 deutsche marks. This year the conversion is $1.00 = 1.6 deutsche marks.

	1992		1991		Change from previous year	
$ Millions[a]	Total	U.S.	Total	U.S.	1992	1991
BASF	na	$ 500	na	$ 550	na	na
Bayer	$1898	325	$1962	310	−3%	−16%
Hoechst	na	550[b]	na	500[b]	na	na
TOTAL	$1898	$1375	$1962	$1360		
ANNUAL CHANGE[c]	−3%	1%	−16%	9%		

a $1.00 = 1.58 deutsche marks. b Includes Celanese Mexicana. c Cumulative change for companies reporting. na = not available.